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(54) Title of the invention: A heat-insulating moisture-permeable fabric

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(57) Scope of Claims

1 A heat-insulating moisture-permeable fabric which is characterized in that a moisture-permeable film comprising polymer material with admixed silver-coloured pigment is formed in the shape of dots on the microporous polymer film of a moisture-permeable fabric produced by forming a microporous film comprising polymer material on a fibre base material.

2 A heat-insulating moisture-permeable fabric according to Claim 1 where the size of each dot is 0.01 to 10 mm^2 and, furthermore, the ratio of the total area of the aforesaid moisture-permeable film region formed in the shape of dots to the total area of the other parts of the surface is in the range 1 : 1 to 4 : 1.

3 A heat-insulating moisture-permeable fabric according to Claim 1 where the polymer material of the aforesaid moisture-permeable film formed in the shape of dots is a material which exhibits a level of moisture-permeability of at least 4000 g/cm^2 when formed into film of thickness 1 μ.

4 A heat-insulating moisture-permeable fabric according to Claim 1 where the aforesaid silver-coloured pigment is a powder-form or flake-form metal, metal oxide or metallized plastic.

5 A heat-insulating moisture-permeable fabric according to Claim 1 where the aforesaid microporous polymer film is three-dimensionally crosslinked by polyisocyanate.

Detailed Description of the Invention

Technical Field

The present invention relates to a heat-insulating moisture-permeable fabric; more particularly, it relates to a heat-insulating moisture-permeable fabric produced by forming a microporous film on a fibre base material.

Prior-Art

Hitherto, as waterproof moisture-permeable fabrics, there have been numerous proposals where a urethane polymer, a polyacrylate ester resin, a tetrafluoro-ethylene resin or the like is coated onto, or laminated to, a fibre base material. However, in recent years, there has been an increasing demand to provide a lagging/heat-insulation function along with such properties, and from the point of view of energy-savings such needs are thought likely to increase more and more. As a proposal to meet this demand, there has been suggested colouration with an aluminium-based silver-coloured pigment so as to reflect the radiant heat generated by the body temperature and thereby to prevent dissipation of the body heat. However, there is the disadvantage that, by such a method, it is difficult to avoid a lowering of the moisture-permeability as a result of the colouration with an aluminium-based silver-coloured pigment. The present inventors have carried out painstaking research into this problem and, as a result, have made the present invention.

Objective of the Invention

The objective of the present invention lies in offering a heat-insulating moisture-permeable fabric which is outstanding in terms of both heat insulation and moisture-permeability.

Constitution of the Invention

In accordance with the present invention, there is provided a heat-insulating moisture-permeable fabric where said fabric is characterized in that a moisture-permeable film comprising polymer material with admixed silver-coloured pigment is formed in the shape of dots on the microporous polymer film of a moisture-permeable fabric produced by forming a microporous film comprising polymer material on a fibre base material.

Detailed Explanation of the Constitution of the Invention

Examples of fibre base materials which are useful in the heat-insulating moisture-permeable fabric of the present invention are nylon, polyester and other such synthetic-fibre or natural-fibre woven materials, knitted materials, nonwoven materials and the like.

When producing the heat-insulating moisture-permeable fabric of the present invention, first of all a microporous film comprising a polymer material is formed on a fibre base material of the kind described above. As examples of polymer materials which give a microporous film which is both waterproof and possesses moisture-permeability, there are polyester-based urethane polymers and polyether-based polymers[i], and also polyacrylate polymers, amino acid-modified urethane

polymers, polytetrafluoroethylene and the like, and the desired microporous film is obtained by coating or laminating such a polymer to the fibre base material by known methods.

Next, a moisture-permeable film comprising a polymer material with admixed silver-coloured pigment is formed in the shape of spots. As the silver-coloured pigment there can be used, for example, powder- or flake-form metal, metal oxide or metallized film, specific examples being a paste of aluminium powder or of flaked such aluminium powder, titanium dioxide processed in the form of flakes, or flakes of a plastic which has been metallized with silver or aluminium. Furthermore, as the polymer material (the binder) in such a film, there can be used polymer of exactly the same kind as described above. In such circumstances, it is preferred that when the material is formed into a film of thickness 1 μ, it exhibits moisture-permeability of at least 4000 g/cm^2. → Mp pu

An amount of the aforesaid pigment such that, following application thereof, sufficient shine/lustre is obtained, for example 30 parts by weight of the pigment per 100 parts by weight of the binder, is mixed with the binder and then, by using a suitable means such as a gravure coater or a rotary screen-printing machine, application is carried out in the form of dots on the microporous film of the fabric. The shape and configuration of the dots are not particularly restricted but it is preferred that they have the following form in terms of enhancing heat insulation and retaining moisture-permeation. Specifically, the size of the dots is appropriately from 0.01 mm^2 to 10 mm^2. At a size less than 0.01 mm^2,

sufficient heat insulation may not be obtained, while a size greater than 10 mm^2 can have the effect of reducing moisture-permeability. Furthermore, the ratio of the total area of the applied dot regions to the total area of the regions where no dots are applied is preferably 1 : 1 to 4 : 1. If this ratio is less than 1 : 1, sufficient heat insulation is not obtained, while if it is greater than 4 : 1 there may be a lowering of the moisture-permeability.

Now, with regard to the fabric provided with the moisture-permeable coating, where there is coated or laminated a resin which is soluble in organic solvents such as DMF (dimethylformamide) or (MEK) methyl ethyl ketone, for example a polyether-based urethane polymer, a polyester-based urethane polymer or a polyacrylate polymer, and in particular in the case of the formation of a microporous film from such a material, when a coating material comprising a polymer material containing silver-coloured pigment is subsequently applied, the DMF, MEK or other organic solvent present in this subsequent coating material will bring about swelling or dissolution of the resin film used to confer both moisture-permeability and waterproofing, and so a marked lowering of the moisture-permeability or of the waterproof character may occur. Even in the case where there is laminated a material such as polytetrafluoroethylene which is insoluble in organic solvents like DMF and MEK, swelling or dissolution of the adhesive agent used for the lamination may occur in the organic solvent such as DMF or MEK. Hence, in such circumstances too a marked lowering of the moisture-permeability or of the water-resisting pressure may arise. Two methods may be considered to prevent such behaviour. One method is to

use an organic solvent of extremely low polarity such as isopropyl alcohol, methyl alcohol, benzene or toluene as the organic solvent for the surface treatment[ii]. With such a solvent, there is little solubility in terms of the resin which has previously been coated or laminated with the object of conferring both moisture-permeability and waterproofing, or in terms of the adhesive agent used for the lamination, and so it is possible to markedly suppress any lowering or the moisture-permeability and waterproofing. However, the types of coating material which can employ an aforesaid low-polar solvent are extremely few and, furthermore, the coating material itself too must not include high-polar DMF or MEK. Moreover, the types of pigment which can be used in such a coating material are restricted on account of the vehicle employed and, consequently, this approach cannot be regarded as a general method.

The other method is extremely revolutionary in that it is simple and can be applied to all the aforesaid binders and pigments used for the heat-insulating moisture-permeable material. Specifically, 2 to 10 parts by weight of a polyisocyanate is added beforehand per 100 parts by weight of the resin coated or laminated with the object of conferring moisture-permeability, or per 100 parts by weight of the adhesive used, and then the formation of the moisture-permeable waterproof film is performed or the adhesion is carried out. The polyisocyanate reacts with moisture in the air, forming a crosslinked structure in the film and, furthermore, it reacts with the terminal hydroxyl groups possessed by the polyurethane polymer or polyacrylic acid polymer, to produce a three-dimensional crosslinked structure in the coated or laminated film, or in the adhesive agent at

the time of lamination, and so said polyisocyanate acts to prevent any swelling or dissolution by organic solvents such as DMF or MEK. When there is used a coated film, a laminated film or an adhesive to which a polyisocyanate has been added in this way, even when there is subsequently applied a coating material which employs DMF, MEK or the like, no lowering of the moisture-permeability or of the waterproof character is observed. Now, if excess polyisocyanate is added, the handle of the fabric becomes harsh and the drape is impaired. On the other hand, with too little, dissolution or swelling is brought about by the DMF or MEK. Hence, as stated above, it is appropriate to use from 2 to 10 parts by weight of the polyisocyanate per 100 parts by weight of the resin or adhesive agent. With this amount, the handle is not impaired and it is possible to obtain sufficient solvent resistance.

The fabric of the present invention obtained in this way possesses high thermal insulation without any loss of its waterproof character and moisture-permeability. Again, there is no impairment of the handle and there is fastness to rubbing, and so there is obtained a high performance fabric which is fully practical.

Examples

Below, the present invention is explained by providing a practical example. Now, in the explanation below, unless otherwise stated reference to 'parts' and '%' are on a weight basis.

Example 1

The following resin was applied at a coverage of 23 g/m^2, by means of a floating system, to one face of a 70d nylon taffeta (warp density = 123 per inch, weft density = 87 per inch) and, after coagulating in water, solvent removal was performed and then drying carried out.

Crisbon 8006 (polyester-based urethane polymer produced by Dainippon Ink)	100 parts
DMF (N,N'-dimethylformamide)	100 parts
Barnock D-500 (blocked isocyanate produced by Dainippon Ink)	5 parts

On top of the aforesaid coated face, there was further applied the following resin liquid at a coverage of 170 g/cm^2 using a roll.over.knife system, then coagulation was performed in water and solvent removal carried out, followed by drying. Curing was performed for 3 minutes at 150°C and a microporous film obtained.

Crisbon 8006	100 parts
DMF	100 parts
Barnock D-500	5 parts

Next, the following resin liquid was printed onto the aforesaid urethane-coated face with a gravure coating machine in the form of 40 mesh dots.

Lackskin U-678 (an amino acid modified urethane polymer produced by Seiko Kasei)	100 parts
MEK (methyl ethyl ketone)	50 parts
pigment: UT-901 (aluminium type silver-coloured pigment, made by Nikko Bics Co.)	20 parts

The ratio of the areas of the regions of dots to the unprinted regions was 2 : 1. Furthermore, in order to confer water repellency, the fabric was immersed in an aqueous solution of an emulsion type fluorine copolymer and, following the padding, drying and then curing were performed.

Comparative Example 1

A moisture-permeable fabric with a urethane polymer microporous film was produced in the same way as in Example 1 after which, without forming a mirror face by gravure coating, immersion was carried out in the aqueous solution of emulsion type fluorine copolymer and, following the padding, drying and then curing were performed.

Comparative Examples 2 and 3

Processing was carried out using the same resin formulations and procedures as in Example 1, except that printing was conducted with the gravure coater mesh changed. Performance was compared when printing was carried out such that the ratio of the total area of the dot regions to the unprinted regions was either 1 : 2 or 10 : 1, and these were taken as Comparative Example 2 and Comparative Example 3 respectively.

Comparative Example 4

After preparing a moisture-permeable fabric with a urethane polymer microporous film in the same way as in Example 1, the following low-moisture-permeable resin liquid was printed onto the urethane coated face in the

same way as in Example 1 using a gravure coater, in the form of 40 mesh dots.

Lackskin U-2216 (a one-part urethane polymer, produced by Seiko Kasei)	100 parts
MEK (methyl ethyl ketone)	50 parts
pigment: UT-901 (aluminium type silver-coloured pigment, made by Nikko Bics Co.)	20 parts

Furthermore, immersion was performed in the aqueous solution of emulsion type fluorine copolymer and, following the padding, drying and then curing were performed. This was taken as Comparative Example 4 and a comparison made with the Example.

Table 1 shows the heat insulation, the moisture-permeability and the water-resisting pressure of the products obtained in Example 1 and in Comparative Examples 1 to 4. It is clear that the example in accordance with the invention showed enhanced heat insulation without any loss of moisture absorption and water-resisting pressure.

Table 1

	Heat Insulation (%)	**Moisture-Permeability ($g/cm^2/24$ hr)**	**Water-Resisting Pressure (mmH_2O)**
Example 1	70	4000	at least 2000
Comp.Example 1	50	4200	1700
Comp.Example 2	50	4500	at least 2000
Comp.Example 3	80	500	at least 2000
Comp.Example 4	70	1500	at least 2000

Now, here, the heat insulation was based on method JIS-L-1096-6-28-2-B (cooling method); the moisture-permeability was based on JIS-Z-0208; and the water-resisting pressure was based on method JIS-L-1092-77-A.

Translator's Notes

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[i] Presumably, this means polyether-based urethane polymers.

[ii] Here, 'for the surface treatment' presumably means 'for preparing the paste used to provide the dots'.